

OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **SWANZEY LAKE** the program coordinators recommend the following actions.

FIGURE INTERPRETATION

- Figure 1: These graphs illustrate concentrations of chlorophyll-a in the water column. Algae are microscopic plants that are a natural part of lake ecosystems. Algae contain chlorophyll-a, a pigment necessary for photosynthesis. A measure of chlorophyll-a can indicate the abundance of algae in a lake. The historical data (the bottom graph) show a *stable* in-lake chlorophyll-a trend, however, chlorophyll concentrations were elevated this season. July concentrations were the highest the lake has ever experienced and were above the New Hampshire mean reference line. Heavy rains were noted prior to testing, and it was also noted that there was an increase in runoff from the watershed during that month. These factors can bring excess nutrients into the lake, which can cause unwanted algal growth. Overall, the average chlorophyll-a concentration was below the state mean. Algal abundance was back to normal in August, but was elevated again in September. The lack of flow at that time could have caused nutrients to accumulate in the lake, which could have increased the algal growth. While algae are present in all lakes, an excess amount of any type is not welcomed. Concentrations can increase when there are external and internal sources of phosphorus, which is the nutrient algae depend upon for growth. It's important to continue the education process and keep residents aware of the sources of phosphorus and how it influences lake quality.
- Figure 2: Water clarity is measured by using a Secchi disk. Clarity, or transparency, can be influenced by such things as algae, sediments from erosion, and natural colors of the water. The graphs on this page show historical and current year data. The lower graph shows a *stable* trend in lake transparency. Mean transparency fell below the average value for New Hampshire lakes for the first time this season, and we hope to see water clarity recover next year. The increased algal abundance may have caused a decrease in water clarity. Also the 2000 sampling season was considered to be wet and, therefore, average transparency readings are expected to be slightly lower than last year's readings. Higher amounts of rainfall usually

cause more eroding of sediments into the lake and streams, thus decreasing clarity.

- Figure 3: These figures show the amounts of phosphorus in the epilimnion (the upper layer in the lake) and the hypolimnion (the lower layer); the inset graphs show current year data. Phosphorus is the limiting nutrient for plants and algae in New Hampshire waters. Too much phosphorus in a lake can lead to increases in plant growth over time. These graphs show a *fairly stable* trend for epilimnetic phosphorus levels and a *generally improving* trend in hypolimnetic levels, which means concentrations are decreasing. Epilimnetic phosphorus concentrations were elevated in July due to the rain, which increased the amount of watershed runoff entering the lake. Hypolimnetic phosphorus concentrations were high in August. Mean phosphorus concentrations in the epilimnion remain below the New Hampshire median reference line, however mean hypolimnetic phosphorus concentrations were back above the reference line. One of the most important approaches to reducing phosphorus levels is educating the public. Humans introduce phosphorus to lakes by several means: fertilizing lawns, septic system failures, and detergents containing phosphates are just a few. Keeping the public aware of ways to reduce the input of phosphorus to lakes means less productivity in the lake. Contact the VLAP coordinator for tips on educating your lake residents or for ideas on testing your watershed for phosphorus inputs.

OTHER COMMENTS

- During our visit this summer, we encountered nearly 50 ducks in the water in front of a resident's home. The monitor explained that there has been a problem with this resident continuously feeding the ducks on the lake. An *E. coli* sample was taken in the area where the ducks were swimming but the result was well below the state standard for surface waters (406 counts per 100 mL). It is not a good idea to supply food to any wild animal, but especially waterfowl. Waterfowl have short digestive tracts and will defecate very near to where the food has been eaten, and this is frequently in the water. It has been documented that waterfowl can defecate 28 times per day. Feces contain the nutrient phosphorus, which we know provides plants and algae with food to grow more abundantly in a lake. Obviously, most lake residents do not welcome the addition of plants and algae. Please try to discourage lake residents from feeding waterfowl and other wild animals for the sake of Swanzey Lake. If the lake association would like to take more *E. coli* samples next year please let us know when calling for an appointment. Also, if you would like more help with this situation please contact the VLAP Coordinator at (603) 271-2658.

- Conductivity levels were slightly increased in the lake this year (Table 6). Conductivity increases often indicate the influence of human activities on surface waters. While the concentrations have not yet reached the excessive level a continued increase is not desirable. Septic system leachate, agricultural runoff, iron deposits, and road runoff can all influence conductivity. It would be useful to uncover the reasons for increased conductivity as we continue to monitor the lake. We will observe the conductivity levels next year to see if they increase further.
- The Pine Inlet A had its highest total phosphorus reading in September (Table 8). The inlet was sampled only once during the summer and may have been stagnant at the time of sampling. We will continue to observe the total phosphorus concentrations in this inlet.
- **Please note** on one occasion this summer the phosphorus concentration at Pine Inlet B was recorded as less than 5 µg/L. The NHDES Laboratory Services adopted a new method of analyzing total phosphorus this year and the lowest value that can be recorded is 'less than 5 µg/L'. We would like to remind the association that a reading of 5 µg/L is still considered low for New Hampshire's waters.
- Dissolved oxygen was low from the mid-thermocline to the bottom in September (Table 9). The process of decomposition in the sediments depletes dissolved oxygen on the bottom of thermally stratified lakes. As bacteria break down organic matter, they deplete oxygen in the water. When oxygen gets below 1 mg/L, phosphorus normally bound up in the sediments may be released into the water column, a process that is referred to as *internal loading*. Depleted oxygen in the hypolimnion usually occurs as the summer progresses. This explains the higher phosphorus in the hypolimnion (lower water layer) versus the epilimnion (upper layer). Since an internal source of phosphorus to the lake is present, limiting or eliminating external phosphorus sources in the lake's watershed is even more important for lake protection. We would like to schedule the annual visit by an NHDES biologist for earlier in the summer, possibly July, so we can determine when the decrease in dissolved oxygen begins. Please contact the VLAP Coordinator at (603) 271-2658 to schedule the annual visit.
- An additional plankton sample was collected in July (Table 2). The most abundant species observed was *Peridinium*, a dinoflagellate. The collected sample had very abundant levels of phytoplankton, which likely lead to the increase in chlorophyll-a during the month.

NOTES

- Monitor's Note (7/5/00): Showers heavy at times yesterday and the same pattern for the last month; lots of runoff in water; plant-like smell to water as you swim.

- Monitor's Note (9/11/00): Nearly 50 ducks seen swimming near shore and sitting on resident's docks. Outlet not flowing over dam.

USEFUL RESOURCES

Bacteria in Surface Waters, WD-BB-14, NHDES Fact Sheet, (603) 271-3503 or www.state.nh.us

A Brief History of Lakes, NH Lakes Association pamphlet, (603) 226-0299 or www.nhlakes.org

Answers to Common Lake Questions, NHDES-WSPCD-92-12, NHDES Booklet, (603) 271-3503.

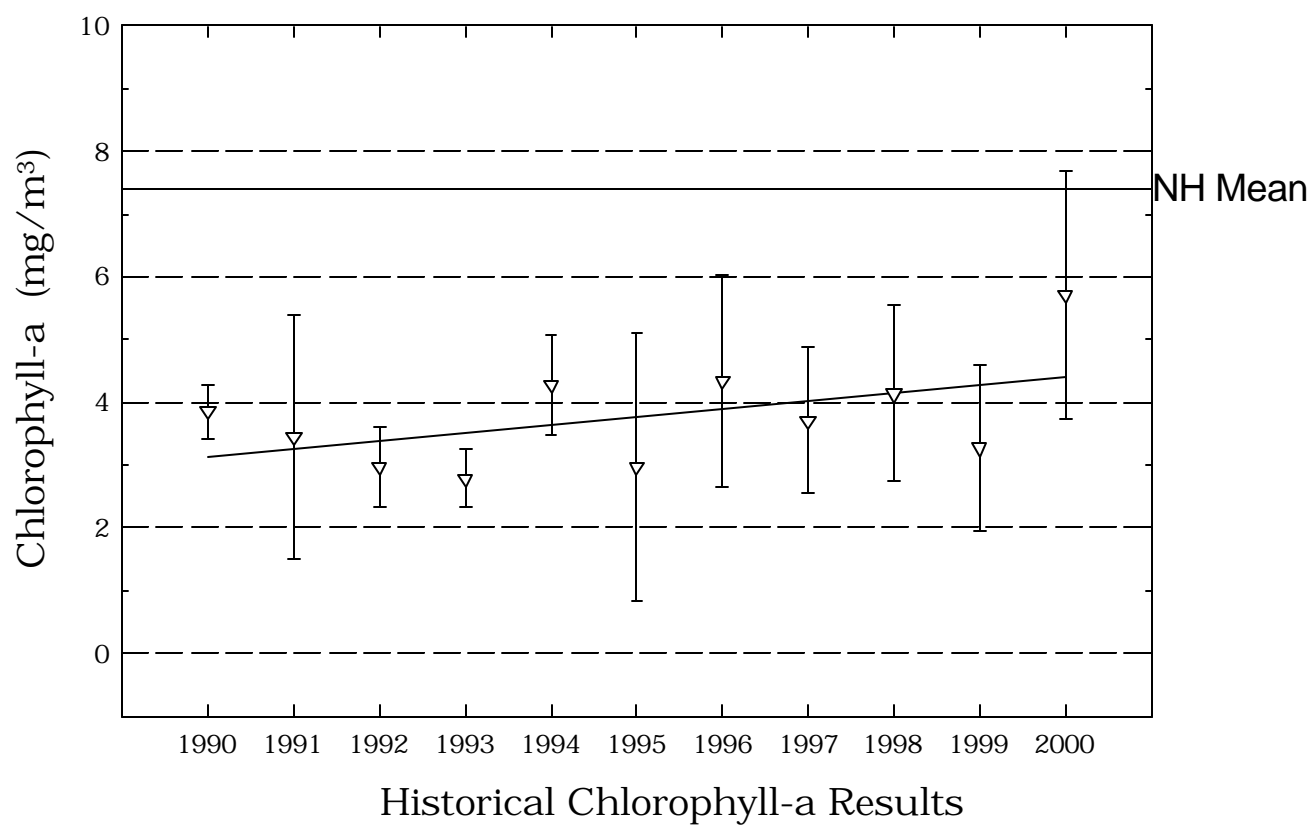
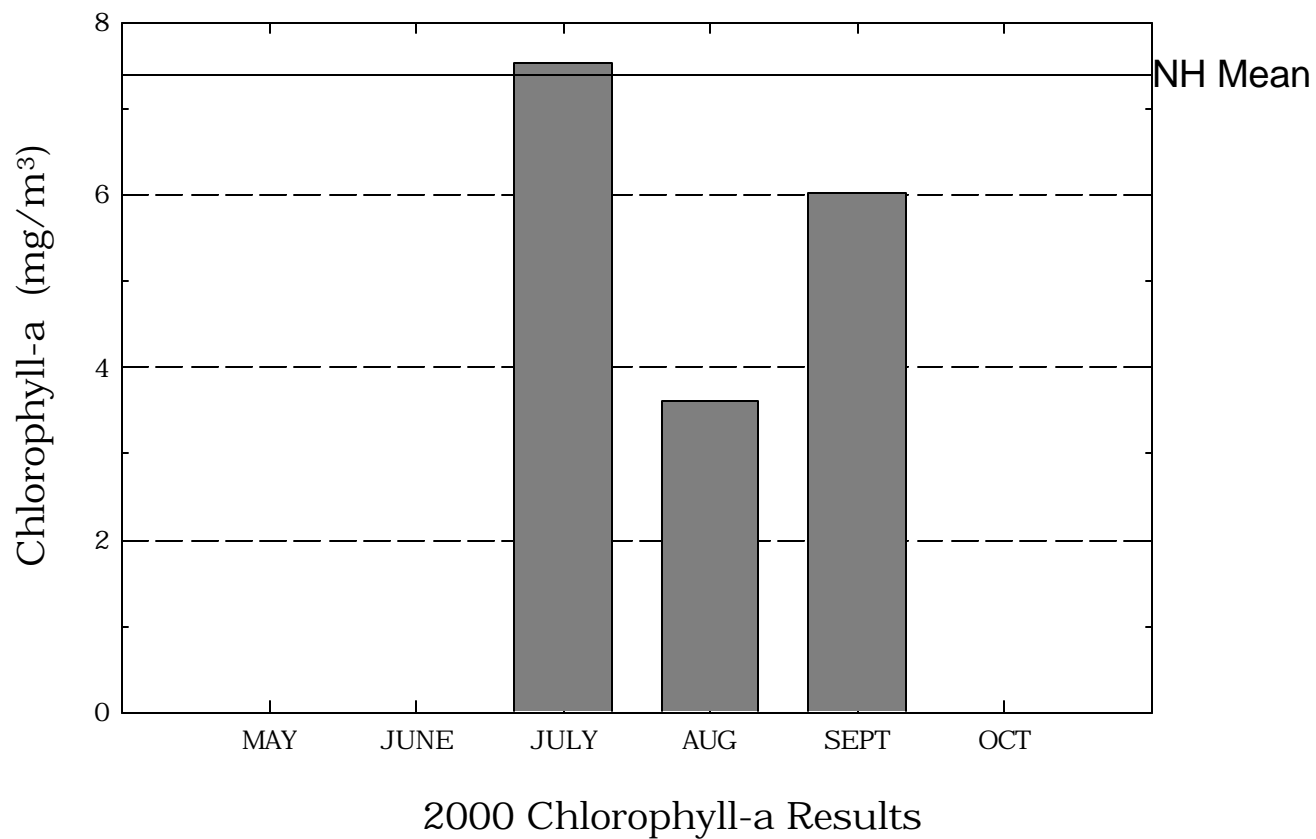
Anthropogenic Phosphorus and New Hampshire Waterbodies, NHDES-WSPCD-95-6, NHDES Booklet, (603) 271-3503

What Can You Do to Prevent Shoreland Erosion?, WD-BB-30, NHDES Fact Sheet, (603) 271-3503 or www.state.nh.us

Low Impact Boating, NH Lakes Association pamphlet, (603) 226-0299 or www.nhlakes.org

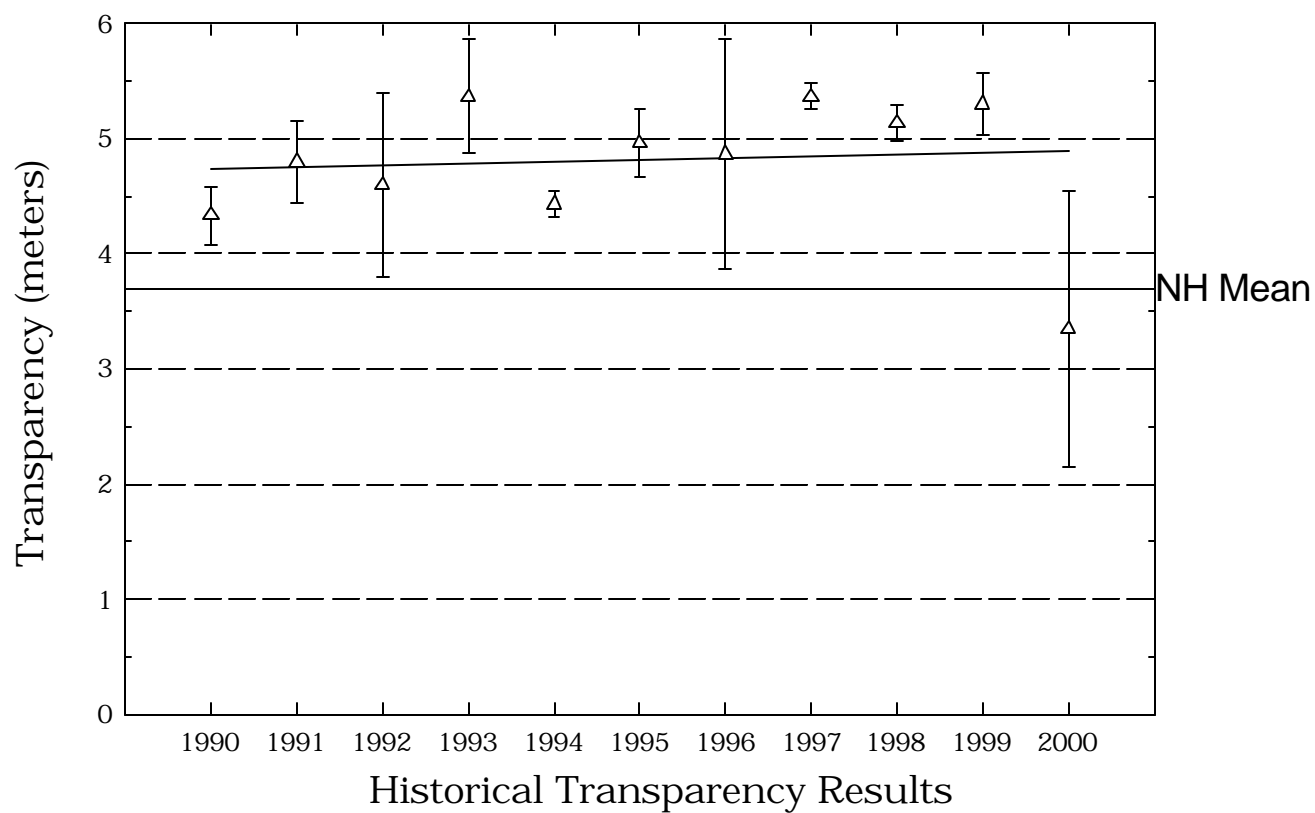
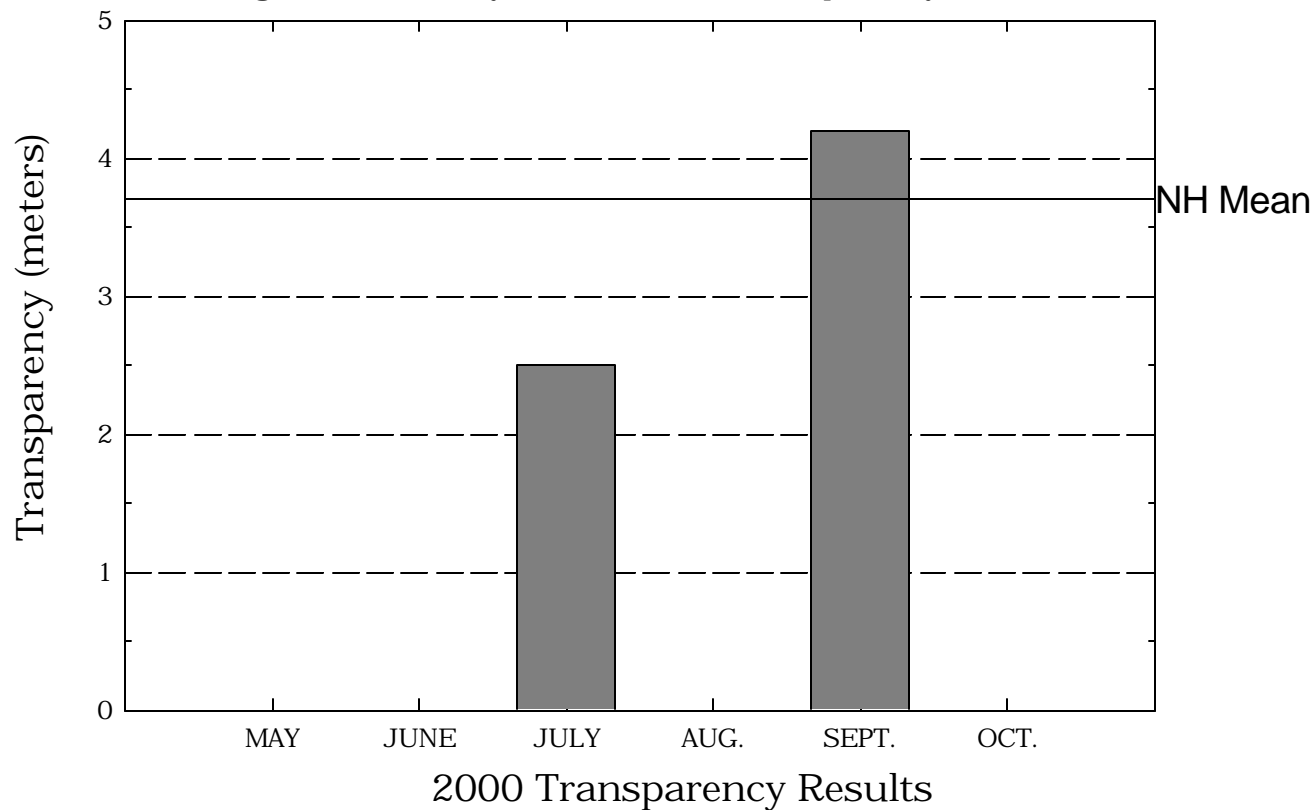
Swanzey Lake

Figure 1. Monthly and Historical Chlorophyll-a Results



Swanzey Lake

Figure 2. Monthly and Historical Transparency Results



Swanzey Lake

Figure 3. Monthly and Historical Total Phosphorus Data.

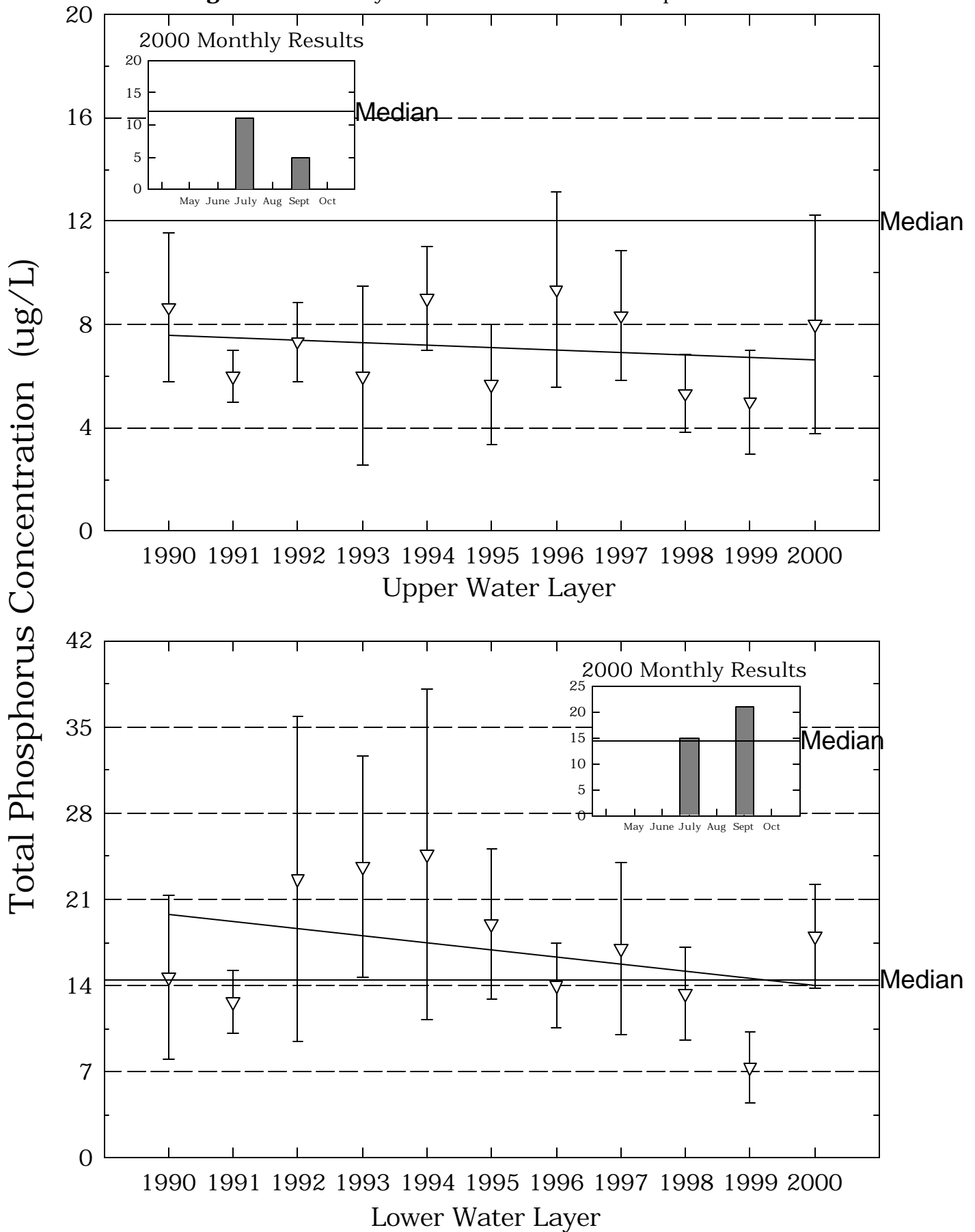


Table 1.**SWANZEY LAKE****SWANZEY**

**Chlorophyll-a results (mg/m³) for current year and historical
sampling periods.**

Year	Minimum	Maximum	Mean
1990	3.38	4.20	3.85
1991	2.00	5.66	3.45
1992	2.37	3.63	2.96
1993	2.35	3.27	2.78
1994	3.34	4.74	4.27
1995	1.11	5.29	2.97
1996	2.54	5.89	4.34
1997	2.37	4.39	3.71
1998	2.92	5.67	4.13
1999	2.16	4.74	3.28
2000	3.61	7.52	5.71

Table 2.**SWANZEY LAKE****SWANZEY****Phytoplankton species and relative percent abundance.****Summary for current and historical sampling seasons.**

Date of Sample	Species Observed	Relative % Abundance
06/11/1990	DINOBRYON	35
	ASTERIONELLA	45
06/17/1991	ASTERIONELLA	88
06/15/1992	CHRYSOSPHAERELLA	64
	ANABAENA	12
	DINOBRYON	9
06/07/1993	ASTERIONELLA	56
	CHRYSOSPHAERELLA	23
07/11/1994	DINOBRYON	53
	ASTERIONELLA	47
07/24/1995	CHRYSOSPHAERELLA	57
	CERATIUM	16
	DINOBRYON	14
07/22/1996	ASTERIONELLA	34
	DINOBRYON	24
	CERATIUM	20
07/28/1997	DINOBRYON	67
	MELOSIRA	7
	ASTERIONELLA	7
07/13/1998	CHRYSOSPHAERELLA	88
	ASTERIONELLA	8
	SYNURA	2
07/26/1999	CHRYSOSPHAERELLA	41
	DINOBRYON	31
	CERATIUM	15
07/12/2000	PERIDINIUM	50
	ASTERIONELLA	25
	DINOBRYON	15

Table 2.

SWANZEY LAKE

SWANZEY

Phytoplankton species and relative percent abundance.

Summary for current and historical sampling seasons.

Date of Sample	Species Observed	Relative % Abundance
09/11/2000	CHRYSOSHAERELLA	75
	DINOBRYON	5
	SYNURA	4

Table 3.**SWANZEY LAKE
SWANZEY****Summary of current and historical Secchi Disk
transparency results (in meters).**

Year	Minimum	Maximum	Mean
1990	4.1	4.6	4.3
1991	4.5	5.2	4.8
1992	3.7	5.2	4.6
1993	4.8	5.7	5.3
1994	4.3	4.5	4.4
1995	4.8	5.3	4.9
1996	4.1	6.0	4.8
1997	5.3	5.5	5.3
1998	5.0	5.3	5.1
1999	5.0	5.5	5.3
2000	2.5	4.2	3.3

Table 4.**SWANZEY LAKE****SWANZEY****pH summary for current and historical sampling seasons.****Values in units, listed by station and year.**

Station	Year	Minimum	Maximum	Mean
EPILIMNION	1990	6.94	7.06	6.99
	1991	6.98	7.10	7.06
	1992	7.00	7.19	7.07
	1993	6.91	7.37	7.08
	1994	6.93	7.07	6.99
	1995	7.03	7.06	7.05
	1996	6.55	6.85	6.72
	1997	6.66	7.54	6.99
	1998	6.04	7.10	6.41
	1999	6.76	6.91	6.81
	2000	6.82	7.03	6.91
HYPOLIMNION	1990	6.25	6.48	6.32
	1991	6.30	6.40	6.34
	1992	6.37	6.51	6.45
	1993	6.30	6.37	6.33
	1994	6.16	6.36	6.22
	1995	6.25	6.60	6.38
	1996	6.04	6.38	6.18
	1997	6.36	6.48	6.41
	1998	6.22	6.39	6.29
	1999	6.10	6.69	6.31
	2000	6.43	6.92	6.61

Table 4.**SWANZEY LAKE****SWANZEY****pH summary for current and historical sampling seasons.****Values in units, listed by station and year.**

Station	Year	Minimum	Maximum	Mean
METALIMNION	1990	6.70	7.18	6.86
	1991	6.60	6.97	6.73
	1992	6.73	7.13	6.90
	1993	6.81	7.45	6.98
	1994	6.73	7.03	6.88
	1995	6.76	7.03	6.90
	1996	6.42	6.90	6.58
	1997	6.89	7.09	7.01
	1998	6.68	6.95	6.82
	1999	6.53	6.62	6.57
	2000	6.26	6.91	6.47
OUTLET	1990	6.74	7.06	6.83
	1991	7.00	7.20	7.09
	1992	6.81	7.05	6.93
	1993	6.54	7.05	6.73
	1994	6.38	6.73	6.58
	1995	6.81	6.91	6.86
	1996	6.66	7.29	6.79
	1997	6.82	7.02	6.93
	1998	6.75	6.91	6.85
	1999	6.71	7.32	6.87
	2000	6.58	6.58	6.58

Table 4.**SWANZEY LAKE****SWANZEY****pH summary for current and historical sampling seasons.****Values in units, listed by station and year.**

Station	Year	Minimum	Maximum	Mean
PINE INLET A	1990	6.55	7.29	6.71
	1991	6.80	7.30	6.93
	1992	6.85	7.21	6.99
	1993	6.54	6.54	6.54
	1994	6.62	6.80	6.70
	1995	6.92	7.09	7.00
	1996	6.39	6.77	6.52
	1997	6.77	6.92	6.82
	1998	6.61	6.91	6.70
	1999	6.77	7.01	6.87
	2000	6.53	6.81	6.65
PINE INLET B	1990	6.56	7.00	6.69
	1991	6.80	7.20	6.93
	1992	6.66	7.00	6.80
	1993	6.42	6.88	6.63
	1994	6.63	6.71	6.68
	1995	6.80	7.08	6.89
	1996	6.70	6.90	6.78
	1997	6.95	7.15	7.03
	1998	6.60	7.03	6.80
	1999	6.78	8.14	7.04
	2000	6.61	6.70	6.65

Table 5.

SWANZEY LAKE

SWANZEY

Summary of current and historical Acid Neutralizing Capacity.

Values expressed in mg/L as CaCO₃.

Epilimnetic Values

Year	Minimum	Maximum	Mean
1990	5.60	6.30	6.00
1991	6.10	6.50	6.27
1992	6.00	7.30	6.57
1993	3.90	7.20	6.00
1994	5.70	7.20	6.37
1995	7.10	7.80	7.43
1996	5.60	6.90	6.23
1997	6.30	7.40	7.00
1998	6.50	7.10	6.73
1999	6.10	7.60	6.70
2000	6.00	6.70	6.35

Table 6.**SWANZEY LAKE
SWANZEY****Specific conductance results from current and historic
sampling seasons. Results in uMhos/cm.**

Station	Year	Minimum	Maximum	Mean
EPILIMNION	1990	36.4	37.0	36.7
	1991	37.6	38.4	37.9
	1992	36.7	40.5	38.2
	1993	33.6	42.2	37.9
	1994	36.5	38.6	37.8
	1995	39.4	41.8	40.3
	1996	37.4	39.3	38.6
	1997	36.8	37.1	37.0
	1998	36.8	38.4	37.8
	1999	40.3	41.3	40.6
	2000	39.4	40.8	40.1
HYPOLIMNION	1990	37.8	42.8	39.6
	1991	40.4	41.9	41.3
	1992	37.4	40.6	38.6
	1993	34.2	42.8	38.3
	1994	36.1	46.1	40.8
	1995	38.3	43.2	40.2
	1996	40.9	43.6	42.3
	1997	36.6	38.9	37.8
	1998	38.7	41.4	40.1
	1999	41.7	42.8	42.2
	2000	40.6	56.9	48.7

Table 6.**SWANZEY LAKE****SWANZEY**

**Specific conductance results from current and historic
sampling seasons. Results in uMhos/cm.**

Station	Year	Minimum	Maximum	Mean
METALIMNION	1990	35.9	36.8	36.4
	1991	36.3	38.8	37.2
	1992	36.2	36.7	36.4
	1993	32.1	40.0	36.0
	1994	33.2	38.9	36.7
	1995	37.8	39.8	38.7
	1996	36.7	39.1	38.1
	1997	35.1	37.2	36.0
	1998	37.1	38.5	37.8
	1999	38.7	41.2	39.6
	2000	40.8	42.2	41.5
OUTLET	1990	39.3	40.1	39.7
	1991	38.0	40.4	38.9
	1992	37.6	40.5	38.8
	1993	38.9	49.1	43.3
	1994	41.2	42.1	41.7
	1995	38.3	40.7	39.6
	1996	39.8	48.1	42.9
	1997	37.6	37.8	37.7
	1998	38.8	40.0	39.5
	1999	40.6	42.1	41.4
	2000	42.8	42.8	42.8

Table 6.**SWANZEY LAKE
SWANZEY****Specific conductance results from current and historic
sampling seasons. Results in uMhos/cm.**

Station	Year	Minimum	Maximum	Mean
PINE INLET A	1990	41.9	99.8	61.2
	1991	50.1	115.9	78.0
	1992	52.2	103.6	70.5
	1993	42.6	42.6	42.6
	1994	57.6	87.2	75.0
	1995	66.5	103.2	84.8
	1996	46.5	96.3	69.7
	1997	78.5	95.2	87.9
	1998	40.9	114.5	68.5
	1999	46.1	91.8	68.9
	2000	42.8	56.8	49.8
PINE INLET B	1990	33.6	42.9	38.5
	1991	36.7	40.3	38.5
	1992	34.9	43.8	39.1
	1993	23.9	52.3	39.4
	1994	41.9	51.3	46.2
	1995	40.6	50.9	44.5
	1996	38.3	41.6	40.3
	1997	37.1	37.9	37.5
	1998	38.4	65.0	47.3
	1999	42.0	109.5	83.2
	2000	42.4	76.6	59.5

Table 8.**SWANZEY LAKE****SWANZEY**

**Summary historical and current sampling season Total
Phosphorus data. Results in ug/L.**

Station	Year	Minimum	Maximum	Mean
EPILIMNION	1990	7	12	8
	1991	5	7	6
	1992	6	9	7
	1993	4	10	6
	1994	7	11	9
	1995	3	7	5
	1996	5	12	9
	1997	6	11	8
	1998	4	7	5
	1999	3	7	5
	2000	5	11	8
HYPOLIMNION	1990	7	19	14
	1991	10	15	12
	1992	11	37	22
	1993	18	34	23
	1994	15	40	24
	1995	12	23	19
	1996	10	16	14
	1997	12	25	17
	1998	9	16	13
	1999	4	9	7
	2000	15	21	18

Table 8.**SWANZEY LAKE****SWANZEY**

**Summary historical and current sampling season Total
Phosphorus data. Results in ug/L.**

Station	Year	Minimum	Maximum	Mean
METALIMNION	1990	7	8	7
	1991	9	11	9
	1992	8	13	10
	1993	6	14	9
	1994	10	10	10
	1995	6	11	9
	1996	8	16	11
	1997	7	27	16
	1998	7	13	9
	1999	4	8	5
	2000	7	9	8
OUTLET	1990	8	12	9
	1991	8	12	10
	1992	8	14	10
	1993	12	22	17
	1994	10	22	15
	1995	9	12	10
	1996	7	11	9
	1997	10	70	30
	1998	3	8	5
	1999	7	10	8
	2000	13	13	13

Table 8.**SWANZEY LAKE****SWANZEY**

**Summary historical and current sampling season Total
Phosphorus data. Results in ug/L.**

Station	Year	Minimum	Maximum	Mean
PINE INLET A	1990	5	9	6
	1991	10	15	11
	1992	6	8	7
	1993	11	11	11
	1994	5	14	8
	1995	3	9	6
	1996	3	13	8
	1997	5	9	6
	1998	4	12	8
	1999	5	6	5
	2000	22	22	22
PINE INLET B	1990	9	28	15
	1991	11	26	20
	1992	8	25	16
	1993	14	31	23
	1994	11	18	14
	1995	6	12	9
	1996	7	13	10
	1997	9	16	11
	1998	5	27	19
	1999	5	25	12
	2000	< 5	14	9

Table 9.
SWANZEY LAKE
SWANZEY

Current year dissolved oxygen and temperature data.

Depth (meters)	Temperature (celsius)	Dissolved Oxygen (mg/L)	Saturation (%)
September 11, 2000			
0.1	21.9	6.9	78.6
1.0	21.9	6.9	78.3
2.0	21.8	6.8	77.6
3.0	21.5	6.6	75.1
4.0	21.3	6.3	71.4
5.0	20.5	5.2	57.4
6.0	16.9	1.0	10.0
7.0	14.2	0.2	2.1
8.0	11.3	0.2	2.1
9.0	10.1	0.2	2.2
10.0	9.4	0.3	2.3
11.0	9.0	0.3	2.5
12.0	8.9	0.3	2.8
13.0	8.8	0.4	3.2
14.0	8.8	0.4	3.6

Table 10.**SWANZEY LAKE****SWANZEY****Historic Hypolimnetic dissolved oxygen and temperature data.**

Date	Depth (meters)	Temperature (celsius)	Dissolved Oxygen (mg/L)	Saturation (%)
June 11, 1990	14.0	7.0	5.0	41.0
June 17, 1991	11.0	7.0	3.9	32.0
June 15, 1992	14.0	6.2	2.9	23.3
June 7, 1993	13.0	6.2	4.0	32.0
July 11, 1994	14.0	6.2	0.1	1.0
July 24, 1995	16.0	6.0	0.2	1.0
July 22, 1996	14.5	6.8	0.2	2.0
July 28, 1997	13.0	7.8	0.7	6.0
July 13, 1998	14.0	7.8	0.2	2.0
July 26, 1999	14.0	9.3	0.8	6.6
September 11, 2000	14.0	8.8	0.4	3.6

Table 11.

**SWANZEY LAKE
SWANZEY**

**Summary of current year and historic turbidity sampling.
Results in NTU's.**

Station	Year	Minimum	Maximum	Mean
EPILIMNION	1993	0.0	0.0	0.0
	1997	0.2	0.4	0.3
	1998	0.2	0.7	0.4
	1999	0.4	0.5	0.4
	2000	0.3	0.8	0.6
HYPOLIMNION	1993	0.0	0.0	0.0
	1997	0.3	0.7	0.5
	1998	0.4	2.3	1.0
	1999	0.6	1.1	0.8
	2000	0.7	1.6	1.2
METALIMNION	1993	0.0	0.0	0.0
	1997	0.3	0.6	0.4
	1998	0.3	0.8	0.5
	1999	0.4	0.5	0.4
	2000	0.6	0.7	0.7
OUTLET	1993	0.0	0.0	0.0
	1997	0.3	0.6	0.4
	1998	0.3	0.9	0.5
	1999	0.7	0.7	0.7
	2000	0.5	0.5	0.5
PINE INLET A	1997	0.1	0.6	0.4

Table 11.**SWANZEY LAKE****SWANZEY****Summary of current year and historic turbidity sampling.****Results in NTU's.**

Station	Year	Minimum	Maximum	Mean
	1998	0.3	0.9	0.5
	1999	0.5	0.7	0.6
	2000	0.2	0.4	0.3
PINE INLET B	1993	0.0	0.0	0.0
	1997	0.3	0.4	0.3
	1998	0.5	3.4	1.9
	1999	0.3	4.1	2.4
	2000	0.3	0.8	0.5

Table 12.

SWANZEY LAKE

SWANZEY

**Summary of current year bacteria sampling.
Results in counts per 100ml.**

Location	Date	E. Coli
DUCK HOUSE		See Note Below
	September 11	15